Humpback Chub Genetics Management Plan

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Outline

- ✓ History of GMP
- ✓ Overview of Policy Regarding Controlled Propagation of Species Listed Under the Endangered Species Act
  - ✓ Genetic Risks
  - ✓ HBC GMP recommendations to avoid these risks

History of Genetics Management Plan

- ✓ Originated as part of HBC Comprehensive Management Plan
- ✓ AMWG passed revised motion in 2006 to fund: “To use $50,000 in funds reprogrammed from CPI to support a HBC Genetics Plan, including a refugia plan and additional sampling”
- ✓ Draft reviewed by HBC Comprehensive Management Plan ADHOC in 2008, comments incorporated: “Recommendation to have externally reviewed”

History of Genetics Management Plan

- ✓ GCMRC facilitated external review in 2009, draft reviewed by 2 genetic experts and 1 hatchery expert and comments were incorporated
- ✓ USFWS Region II Regional Office review in 2010, cleared for external release
- ✓ Final provided to BOR in November 2010

Policy

- ✓ Policy Regarding Controlled Propagation of Species Listed Under the Endangered Species Act (CPP)
  - ✓ Fish and Wildlife Service
  - ✓ National Marine Fisheries Service
- ✓ Federal Register
  - ✓ Vol. 65 No. 183, September 20, 2000
- ✓ Pacific salmon are exempted from this policy

Risks That Must Evaluated:

- ✓ Broodstock Mining
- ✓ Inbreeding
- ✓ Introgression
- ✓ Loss of Population Structure
- ✓ Domestication Selection

Risk: Broodstock Mining

- Removal of natural parental (adults) stock that may result in an increased risk of:
  - extinction by reducing the abundance of wild individuals
  - reducing genetic variability within naturally occurring populations

HBC - Recommendations

- ✓ Collect young-of-year
  - ✓ two assurance populations -
    - ✓ 200 YOY/alternate years for 5 years = 1,000 total per assurance population
  - ✓ translocations
    - ✓ 200 YOY per event
- ✓ Probability of their survival would have been low
- ✓ Does not recommend moving adults

Risk: Inbreeding

- ✓ The potential for an increased level of inbreeding or other adverse genetic effects within populations that may result in the enhancement of only a portion of the gene pool.

HBC - Recommendations

- ✓ Maintain pedigree record information
  - ✓ studbook keeper - designate preferred spawning pairs

Risk: Hybridization/Outbreeding

- ✓ Genetic introgression, which may diminish local adaptation of the naturally occurring population.

HBC - Recommendations

- Lower basin - lacks populations sub-division
  - can move around without harm
- Lower basin different from Upper basin
  - do not mix the two
- Move YOY

Risk: Domestication Selection

- ✓ Exposure to novel selection regimes in controlled environments that may diminish a listed species' natural capacity to survive and reproduce in the wild.

HBC - Recommendations

- ✓ Maintain captive stock in outdoor ponds not in raceway culture
- ✓ NATURES rearing

Risk: Loss of Population Structure

- ✓ Potential erosion of genetic differences between populations as a result of mixed stock transfers or supplementation.

HBC - Recommendations

- ✓ Lower basin - lacks populations sub-division
  - ✓ can move around
- ✓ Lower basin different from Upper basin
  - ✓ do not mix the two

Other Risks (not in policy)

- ✓ Founder Effect
- ✓ Genetic Drift
- ✓ Augmentation/Ryman-Laikre Effect

Risk: Founder Effect

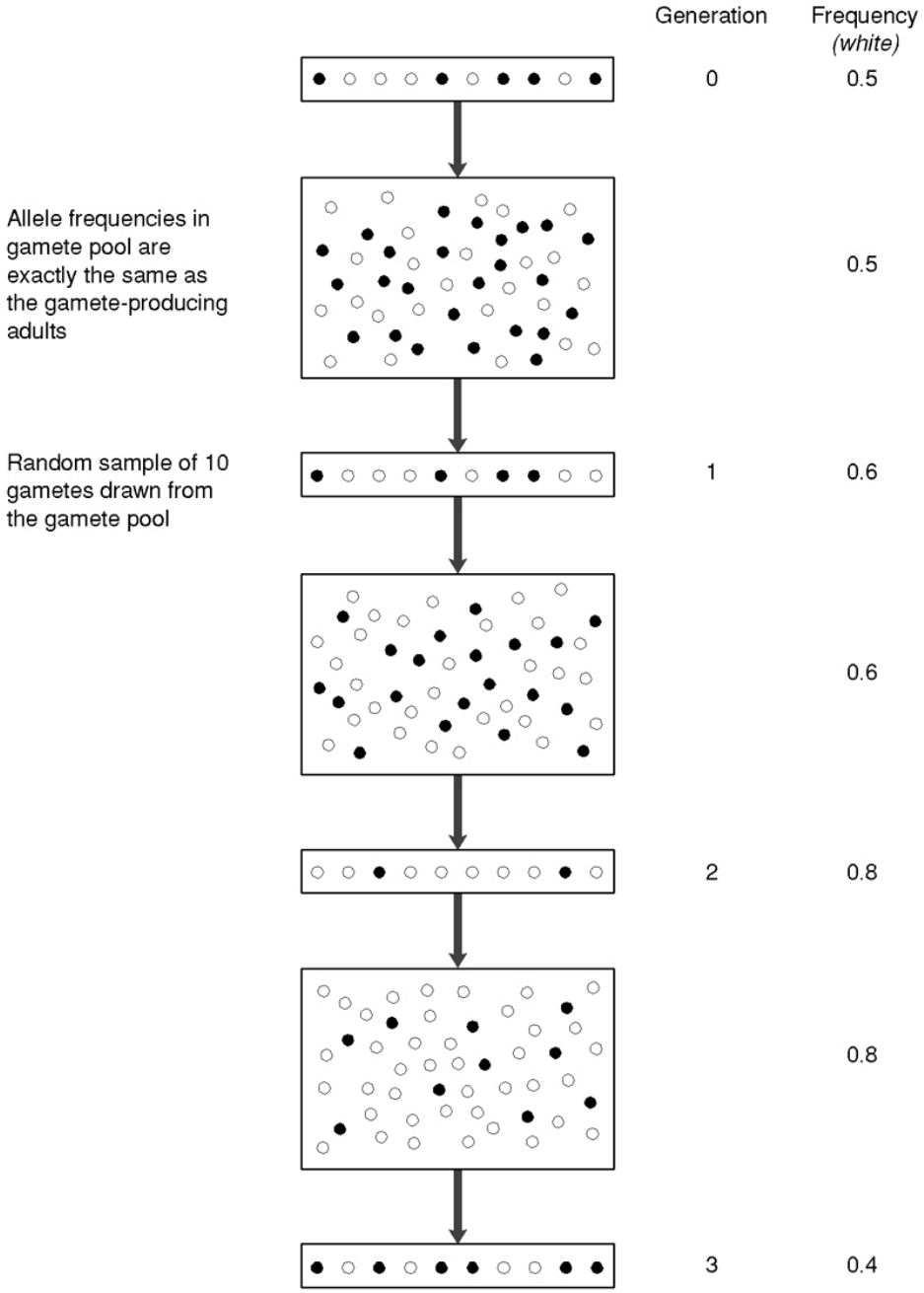
- Occurs when new population is started with few individuals
  - lower genetic diversity than source population

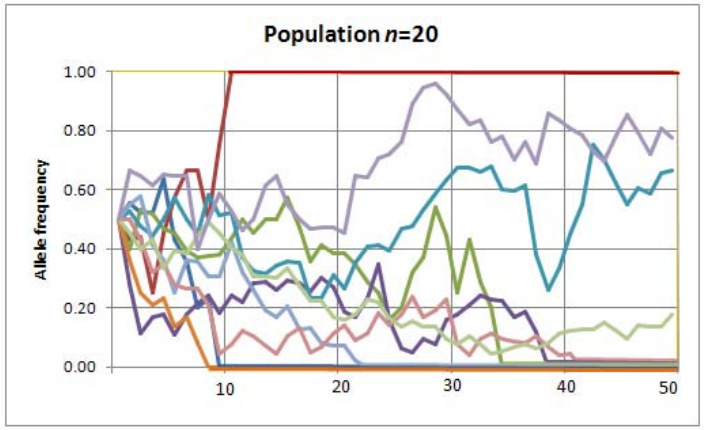
HBC - Recommendations

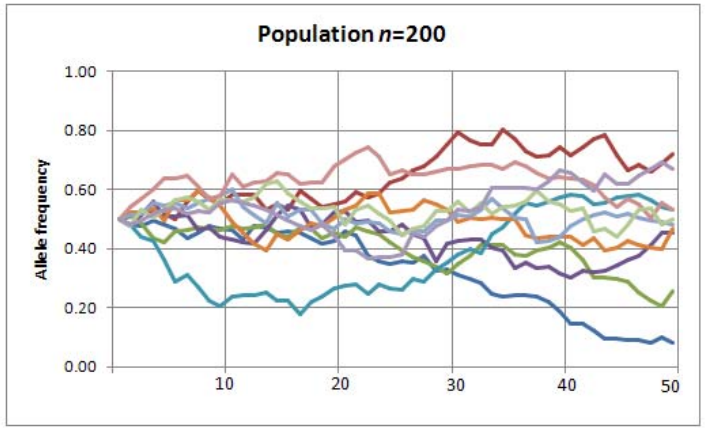
- ✓ 200 YOY per event
  - ✓ translocation
  - ✓ collection for assurance populations
- ✓ PIT tagged and genotype all individuals
  - ✓ compare diversity to source population

Risk: Genetic Drift

- Genetic changes in a population associated with chance events
  - few individuals contribute genes to next generation by chance
  - loss of population diversity due to drift typically associated with small population size


Generation
Frequency
(white)
0
0.5
Allele frequencies in gamete pool are exactly the same as the gamete-producing adults
0.5
Random sample of 10 gametes drawn from the gamete pool
1
0.6
0.6
2
0.8
0.8
3
0.4


Population n=20
Allele frequency
1.00
0.80
0.60
0.40
0.20
0.00
10
20
30
40
50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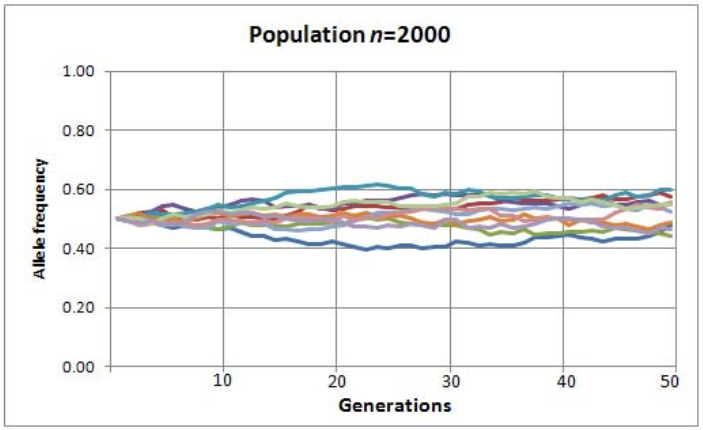
Population n=2000
Allele frequency
1.00
0.80
0.60
0.40
0.20
0.00
10
20
30
40
50
Generations

Genetic Drift - Potential Risks

- ✓ Loss of alleles or reduction in genetic diversity
- ✓ Increase in genetic distance from source population/stock
- ✓ Fixation of deleterious mutations

HBC - Recommendations

- ✓ Monitor genetic variability
  - ✓ captive stock
  - ✓ wild populations
    - ✓ ongoing population monitoring - 30 individuals per year for duration of the management activity
      - ✓ especially translocation localities
- ✓ Spawn greater than 10 pairs
  - ✓ not in plan but general rule (Echelle, T. 1988)
    - ✓ minimum 25 pair
    - ✓ 50 - 100 pair for recovery
    - ✓ 100 pair for new broodstock

HBC - Recommendations

- Maintain large population sizes
  - greater than 500
- Effective Population Size - not all individuals (census size) breed each year
  - fraction that do = effective population size and on average is 14%

HBC - Recommendations

- ✓ Recover plan (2,100 individuals)
  - ✓ Ne = 294
- ✓ Assurance Population A (1,000 indiv.)
  - ✓ Ne = 140
- ✓ Assurance Population B (1,000 indiv)
  - ✓ Ne = 140

HBC - Recommendations

- ✓ Total (captive and assurance)
  - ✓ 4,100 individuals
  - ✓ Ne = 574
- ✓ Close to theoretical 5,000 individuals needed to maintain genetic diversity over 100 year period
- ✓ Minimum theoretical number is 500, but plan calls for 2,100

Risk: Augmentation/Ryman-Laikre Effect

- ✓ Impact of the genetics of a wild population as a result of augmentation
  - ✓ swamping of wild genetic diversity
    - ✓ low genetic diversity but large numbers of propagated individuals

HBC - Recommendations

- ✓ Equalize family sizes
  - ✓ no more than 5,000 from any one pair should be stocked

Thank You

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